REMARKS/ARGUMENTS

The Applicants respectfully request reconsideration in light of the amendments set forth above and the arguments set forth below. Within the Office Action, claims 1-25, 29-31, and 33-38 are rejected under 35 U.S.C. § 103(a). By way of the above amendment, both the Specification and claim 1 have been amended, and claims 39 and 40 have been added. Accordingly, claims 1-25, 29-31, 33-40 are now pending.

The amendments to the Specification find support in the provisional application that this application incorporates by reference.

The amendments to the Specification do not add new matter because they find support in the provisional application, Serial No. 60/163,121, filed November 2, 1999, and titled "A HIGH THROUGHPUT CLUSTER TOOL FOR CLEANING SEMICONDUCTOR DEVICES USING SUPERCRITICAL CO_2." This provisional patent application was incorporated by reference in this case.

By the above amendments, the paragraph on page 6, lines 5-17, now recites specific wafer sizes. This language finds support in the provisional application at, for example, page 3, where it is stated:

> Loader Module. Atmospheric module containing a variable number of cassettes [sic] boxes for wafer sizes greater than 2 inch (e.g.: 3, 4, 5, 6, 8, 12 or greater), or FOUP boxes for wafer sizes greater than 8 inch or cassettes for flat panel displays of various sizes, or cassettes for optical storage devices or the like.

Accordingly, the amendment to the paragraph on page 6, lines 5-17, does not add new matter.

By the above amendments, the paragraph from page 7, line 27, to page 8, line 8, now recites that pressures within the ante-chamber 77 can exceed 1,000 psi . This language finds support at page 7 of the provisional application, under the section heading AC:

> The LA [Loader Arm] retracts and valve 1 closes. Now the AC [ante-chamber] gets pressurized to a pressure that is similar to the PM [Process Module] pressure (at least 1000 psi). This pressurization can occur with SCC, inert gases, nitrogen or the like. Now the workpiece can be moved into the PM.

Accordingly, no new matter has been added by the above amendments to the paragraph on page

7, line 27, to page 8, line 8.

Rejections under 35 U.S.C. § 103(a)

Within the Office Action, claims 1, 6-8, 15-17, 19-20, 25, 29-31 and 33 are rejected under 35 U.S.C. § 103(a) as being anticipated by Bok *et al.*, "Supercritical Fluids for Single Wafer Cleaning," Solid State Technology, June 1992, at 117-120 ("Bok"), in view of JP 08206485 to Shigeru Ueno ("Ueno"). The Applicants respectfully traverse these rejections.

Bok

Bok teaches a system for cleaning wafers using supercritical fluids. The system comprises a chamber that cleans a wafer by pulsating a floor of the chamber, thus varying a height, and thus a volume, of the chamber. As stated in Bok, at page 118:

> During the cleaning cycle, the supercritical fluid is pulsated by a hydraulic mechanism. The lower chamber block is actually a thin-walled, stainless steel membrane, i.e., a diaphragm. The hydraulic fluid pressure changes the chamber height via elastic deformation of the diaphragm, i.e., the supercritical fluid pressure is varied according to the volume of the cleaning chamber.

At page 118, column 2, Bok describes in more detail how his apparatus cleans. Bok teaches that cleaning is performing by compressing and decompressing the diaphragm and thus the volume of the cleaning chamber to mix and whirl fluid within the cleaning chamber. During compression (when the pressure within the cleaning chamber is highest) the cleaning fluid changes to a supercritical fluid. In this state, "the cleaning fluid penetrates molecular layers and micrometer-sized crevices. Substantial fluid movement contributes to mechanical scrubbing, particle dislodging, and dissolving of organic material." During decompression (when the pressure within the cleaning chamber is smallest), the cleaning fluid changes to a subcritical gas. This decrease in density "cause[s] rapid mixing actions and outflow of fluid from the wafer surfaces."

On page 118, at both columns 1 and 3, Bok discloses introducing fresh fluid into the cleaning chamber by first dropping a lower chamber block so that a gap is opened to atmosphere and then introducing clean fluid into the cleaning chamber. Bok thus discloses that when a fluid is expelled from the cleaning chamber, it is in a subcritical state.

As stated at page 118, column 3, of Bok "the wafer [within the cleaning chamber] floats freely in a supercritical fluid." Bok teaches that this structure allows cleaning both sides of a wafer simultaneously. "This is accomplished by properly timing the inflow of fluid through the lower input valve, so that the wafer is always floating on a cushion of fluid." *Id.* Bok does not teach a fixed substrate holder as recited, for example, in claim 40 of the present invention.

At page 118, second column, Bok further states that "[t]he wafer cleaning chamber is designed for an 8 in. wafer." As described below, there is no reasonable expectation that Bok could process wafers larger than 8 inches.

When the present application was filed, one skilled in the art would not reasonably expect that Bok can be used in a cluster tool as recited in the claims.

Bok cannot be used to reject the claims of the present invention because one skilled in the art would not reasonably expect that Bok could work in a cluster tool as recited in the claims of the present invention. Under Federal Circuit law, as well as the rules governing practice before the U.S.P.T.O., a § 103 rejection can stand only if there exists a reasonable expectation that prior art can work successfully when combined. *See, e.g., Life Techs., Inc. v. Clontech Lab., Inc.*, 224 F.3d 1320, 1326 (Fed. Cir. 200) (holding that even ultimate success cannot support a § 103 rejection if there is no reasonable expectation of success at the time of the invention); M.P.E.P. § 2143.02 (8th ed. 2001). As described below, for several reasons, one skilled in the art at the time of the present invention would not expect Bok to work when combined with other references, as asserted by the Examiner.

Bok is not designed to withstand pressures above 1,500 psi.

At page 119, from column 1 to column 2, Bok describes the structure of the diaphragm needed to clean a wafer:

> The diaphragm was a key element of the equipment design. The diaphragm needed to be thin enough to undergo significant elastic deformation, yet strong enough to withstand the high operating pressures of the process equipment. The chamber is presently designed to withstand continuous operating pressures up to 1500 psi.

In other words, because the diaphragm must be thin enough to elastically deform, it cannot operate at pressures greater than 1500 psi. At pressures greater than 1500 psi, the diaphragm may lose its elasticity or, worse, rupture.

In sum, Bok does not teach a supercritical processing module that can withstand pressures above 1,500 psi, as recited in claim 1 of the present invention.

The rejections under § 103 are improper because Bok cannot be adapted to use a circulation loop.

Because Bok uses compression and decompression cycles, it cannot be modified to contain a circulation loop. Bok requires a closed cleaning chamber whose volume decreases and increases during compression and decompression cycles. If Bok were modified to contain a circulation loop, during the compression cycle the fluid would be pushed out of the cleaning chamber, along the circulation loop. No agitation and thus no cleaning of a substrate would occur within the cleaning chamber in the manner described in Bok. Moreover, because the fluid would be pushed out of the cleaning chamber–not contained within the chamber to be converted into a supercritical fluid–the wafer could not be cleaned by a supercritical fluid. In other words, if Bok were modified to contain a circulation loop, it would not work as intended. Thus, Bok cannot be modified to contain a circulation loop as recited in the independent claims 1, 29, 30, and 34 of the present invention.

Those skilled in the art will also recognize that a wafer undergoing processing in the chamber of Bok would likely break if supercritical fluid were circulated within the chamber as asserted by the Examiner. Because the wafer in Bok floats on a cushion of fluid, a pressure differential would exist between a first part of the wafer (near where the fluid is introduced) and a second part of th wafer (where the fluid id removed). If this circulation were performed in a supercritical (i.e., high pressure) environment, the resulting high pressure differential would cause the wafer to break.

Because Bok cannot be modified to contain a circulation loop, the rejection of claims 1, 29, 30, and 34 are improper and should be withdrawn.

There is no reasonable expectation that Bok can process wafers larger than 8 inches.

When the present invention was filed, and even today, one skilled in the art would not expect Bok to successfully process wafers larger than 8 inches, as recited in the new claim 40. Bok specifically states that it is configured to process 8 inch wafers. If the chamber in Bok were enlarged to accommodate wafer sizes larger than 8 inches, the diaphragm's diameter would also have to be enlarged to induce pressure variations like those disclosed.

If the diaphragm retained its thickness, it would be more susceptible to breakage since the central portion would have less support from the edges. Alternatively, the thickness of the diaphragm could be increased. In this case, the diaphragm would have less elasticity, preventing it from pulsating at the required frequency or, alternatively, preventing it from deforming sufficiently to create necessary pressure variations within the processing chamber. To prevent rupturing the diaphragm, the pressure in the chamber can be reduced. In this latter case, supercritical conditions might not even be reached.

Bok cannot be used for wafers larger than 8 inches for a second reason: these larger wafers cannot withstand the pulsations used by Bok. Larger wafers are less able to handle the variable stresses generated by the structure in Bok. Moreover, these larger wafers have smaller geometries that can collapse when exposed to these variable stresses.

Ueno

Figure 1 in Ueno discloses a cleaning tank 1 coupled to a circulation passage 7. The circulation passage 7 contains a circulation machine 2 for circulating a supercritical fluid. Ueno does not teach coupling its cleaning tank to a cluster tool, as recited in the independent claims of the present invention.

Claims 1, 6-8, 15-17, 19, 20, 25, 29-31, and 33

Claim 1 recites an apparatus for supercritical processing of a workpiece. The apparatus comprises a transfer module having an entrance; a supercritical processing module coupled to the transfer module, the supercritical processing module having a workpiece cavity for holding the workpiece during high pressure processing; a non-supercritical processing module coupled to the transfer module; a transfer mechanism coupled to the transfer module, the transfer mechanism configured to move the workpiece between the entrance, the supercritical processing module, and

the non-supercritical processing module; a circulation line coupled to the workpiece cavity and configured to circulate a supercritical fluid along the circulation line and through the workpiece cavity in a supercritical state. During circulation, the supercritical fluid remains in a supercritical state as it travels along the circulation line and through the wafer cavity.

Within the Office Action, the Examiner asserts that it would have been obvious to one skilled in the art to combine Bok with the recirculation line in Ueno to achieve the invention recited in the independent claims 1, 29, and 30. However, as recognized in M.P.E.P. § 2143.01 at 2100-124 (8th ed. 2001), the Federal Circuit has held that prior art cannot be combined to support a rejection under § 103 when the combination would render the prior art unsatisfactory for its intended purpose. *In re Gordon*, 733 F.2d 900, 902 (Fed. Cir. 1984). Here, combining Ueno with Bok would render Bok unsatisfactory for its intended purpose. As described above, Bok pulses a diaphragm to change the height of a chamber, thereby cleaning a wafer contained within the chamber. As explained above, this structure would not work satisfactorily if the chamber were coupled to a circulation loop, such as recited in the independent claim 1 of the present invention. For at least this reason, the rejection of claim 1 in light of Bok and Ueno is improper and should be withdrawn.

While the Applicants believe that the rejection of claim 1 is improper, claim 1 has nevertheless been amended in order to advance this case. As amended, claim1 now recites 'The supercritical processing module [is] configured to withstand pressures above 1,500 psi." As explained above, Bok does not teach, suggest, or provide any motivation for processing wafers above 1,500 psi. Indeed, Bok cannot process wafers above 1,500 psi. For this additional reason, the rejection of claim 1 is improper and should be withdrawn.

Claims 6-8, 15-17, 19, 20, 25, 31 33, and 40 all depend from claim 1. As described above, claim 1 is allowable. Accordingly, claims 6-8, 15-17, 19, 20, 25, 31, 33, and 40 are all also allowable as depending on an allowable base claim.

Claim 29 recites an apparatus for supercritical processing a workpiece. The apparatus comprises means for transferring the workpiece configured to transfer the workpiece into a transfer module; means for supercritical processing having a workpiece cavity and configured such that in operation the means for transferring transfers the workpiece to the means for supercritical processing and further such that in operation the means for supercritical processing processes the workpiece within the workpiece cavity; means for non-supercritical processing configured such that the means for transferring transfers the workpiece to the means for non-supercritical processing and further such that the means for non-supercritical processing

processes the workpiece; and means for circulating a supercritical fluid along the means for circulating and through the workpiece cavity in a supercritical state. As described above, Bok cannot be combined with Ueno to achieve a cluster tool having a non-supercritical processing module and a supercritical processing module having a circulation loop, as recited in claim 29. For at least these reasons, the rejection of claim 29 in light of the teachings of Bok, Ueno, and their combination is improper and should be withdrawn.

Claim 30 recites an apparatus for supercritical processing of a workpiece. The apparatus comprises a hand-off station; a supercritical processing module coupled to the hand-off station, the supercritical processing module having a workpiece cavity and configured to perform supercritical processing on the workpiece within the workpiece cavity; a non-supercritical processing module coupled to the hand-off station; a transfer mechanism coupled to the hand-off station, the transfer mechanism configured to move the workpiece between the entrance, the supercritical processing module, and the non-supercritical processing module; and a circulation line coupled to the supercritical processing module and configured to maintain a supercritical fluid in a supercritical state and to circulate the supercritical fluid through the workpiece cavity.

As described above, Bok cannot be combined with Ueno to achieve a cluster tool having a non-supercritical processing module and a supercritical processing module having a circulation loop, as recited in claim 30. For at least these reasons, the rejection of claim 30 in light of Bok, Ueno, and their combination is improper and should be withdrawn.

Claims 2-5, 9, 10 and 22-24

Within the Office Action, claims 2-5, 9, 10, and 22-24 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Bok in view of Ueno as applied to claims 1, 6-8, 15-17, 19, 20, 25, 29-31, and 33, and further in view of U.S. Patent No. 6,110,232 to Chen. The Applicants respectfully traverse these rejections.

Claims 2-5, 9, 10, and 22-24 all depend from claim 1. As explained above, claim 1 is allowable over the teachings of Bok, Ueno, and their combination. Accordingly, claims 2-5, 9, 10, and 22-24 are all allowable as depending on an allowable base claim.

Claims 11 and 12

Within the Office Action, claims 11 and 12 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Bok in view of Ueno as applied to claims 1, 6-8, 15-17, 19, 20, 25, 29-31, and 33, and further in view of U.S. Patent No. 6,235,634 to White ("White"). The Applicants respectfully traverse these rejections.

Claims 11 and 12 both depend from claim 1. As explained above, claim 1 is allowable over the teachings of Bok, Ueno, and their combination. Accordingly, claims 11 and 12 are both allowable as depending on an allowable base claim.

Claims 13, 14, 18, and 21

Within the Office Action, claims 13, 14, 18, and 21 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Bok in view of Ueno as applied to claims 1, 6-8, 15-17, 19, 20, 25, 29-31, and 33, and further in view of U.S. Patent No. 6,077,321 to Adachi. The Applicants respectfully traverse these rejections.

Claims 13, 14, 18, and 21 all depend from claim 1. As explained above, claim 1 is allowable over the teachings of Bok, Ueno, and their combination. Accordingly, claims 11 and 12 are both allowable as depending on an allowable base claim.

Claims 34-38

Within the Office Action, claims 34-38 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Bok in view of Ueno as applied to claims 1, 6-8, 15-17, 19, 20, 25, 29-31, and 33, and further in view of U.S. Patent No. 6,355,072 to Racette et al ("Racette"). The Applicants respectfully traverse these rejections.

Like the independent claim 1, claim 34 also recites an apparatus having a non-supercritical processing module coupled to a supercritical processing module defining a workpiece cavity, and a circulation line for circulating supercritical fluid through the workpiece cavity in a supercritical state. Thus, for the same reasons as claim 1, the independent claim 34 is also allowable over the teachings of Bok, Ueno, and their combination. Accordingly, claim 34 is allowable over the teachings of Bok and Ueno in view of Racette.

Claims 35-38 all depend from claim 34. As explained above, claim 34 is allowable over Bok and Ueno in view of Racette. Accordingly, claims 35-38 are all also allowable as depending from an allowable base claim.

CONCLUSION

For the reasons given above, the Applicants respectfully submit that claims 1-25 and 29-31, and 33-40 are in condition for allowance, and allowance at an early date would be appreciated. If the Examiner has any questions or comments, he is encouraged to call the undersigned at (408) 530-9700 so that any outstanding issues can be expeditiously resolved.

Respectfully submitted,

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